

A PEAR Shaped Model For Better Human Factors

Maintenance human factors programs do not have to be complex, expensive, nor a burden. **Dr. William B. Johnson** and **Dr. Michael E. Maddox** consider the main HF topics and their relevance to safety management*. Once identified these topics can help in the development of a safety management system (SMS).

There are plenty of excellent resources available to help an organization tailor its human factors (HF) program.

For nearly 20 years the Federal Aviation Administration (FAA) has provided extensive information on HF <www.hf.faa.gov>. More recently the European Aviation Safety Agency (EASA) <www.easa.eu.int/> and Transport Canada <www.tc.gc.ca> have also published HF information. A recent Google search of the term 'maintenance human factors' delivered 11,300 hits. The real challenge is in converting the vast amounts of information into clear and practical solutions.

FAA recently published the 'Operator's Manual for Human Factors in Aviation Maintenance' <www.hf.faa.gov/opsmanual>. This 25-page document, published in English, Spanish, and Chinese, offers guidance on the five most important components of a maintenance HF program: event reporting; use of technical documentation; HF training; shift and task turnover; and fatigue. In 2006 the FAA Administrator acknowledged the Manual, which takes a systematic approach to HF, with an award for its use of 'plain language'.

Mnemonic

Application of the memory aid 'PEAR' makes recognition and mitigation of HF even easier. 'PEAR' has been used as a mnemonic for over a decade to characterize HF in aviation maintenance**. It prompts recall of the four important considerations for HF programs: People who do the job; Environment in which they work; Actions they perform; Resources necessary to complete the job.

HF programs help minimize errors and

complement the design of safety management systems (SMS). Aviation maintenance HF programs focus on the people who perform the work, addressing their physical capabilities, mental state, cognitive capacity, and conditions that may affect interaction with others.

In most cases HF programs are designed around the people in a company's existing workforce. One cannot apply identical strength, size, endurance, experience, motivation, and certification standards equally to all employees and companies must match the physical characteristics of each person to the tasks they perform. A company must consider factors such as each person's size, strength, age, eyesight and more, to ensure that they are physically capable of performing all of the tasks that make up the job. A good HF program will consider the limitations of humans and design the job accordingly.

An important element when incorporating HF into job design is planned rest breaks. People can suffer physical and mental fatigue under many work conditions. Adequate breaks and rest periods will ensure that the strain of the task does not overload their capabilities.

Another People consideration, also related to 'E', for Environment, is ensuring that there is proper lighting for the task, especially for older workers. Annual vision testing, supplemented with hearing tests, are excellent proactive interventions that will ensure optimal human physical performance.

Attention to the individual does not stop at physical abilities. A good HF program must address physiological and psychological factors that affect performance. Companies should do their best to foster good physical and mental

health. Offering educational programs on health and fitness is one way to encourage good health. Many companies have reduced sick leave and increased productivity by making healthy meals, snacks and drinks available to their employees. Companies should also have programs to address issues associated with chemical dependence, including tobacco and alcohol.

Another People issue involves teamwork and communication. Safe and efficient companies find ways to foster communication and cooperation among the workers, managers, and owners. For example, workers should be rewarded for finding ways to improve the system, eliminate waste, and help ensure continuing safety.

Environments

There are at least two environments in aviation maintenance: the physical workplace on the ramp, in the hangar, or in the shop; and there is also the organizational environment that exists within the company. An HF program must pay attention to both.

The physical environment is perhaps more obvious and it includes ranges of temperature, humidity, lighting, noise control, cleanliness, and workplace design. Companies must acknowledge these conditions and cooperate with the workforce to either accommodate or change the physical environment. It takes a corporate commitment to address the physical environment. This topic overlaps with the Resources component of PEAR when it comes to providing portable heaters, coolers, lighting, clothing, and workplace and task design.

The second, less tangible, environment is the organizational one. The important factors in an organizational environment are typically related to cooperation, communication, shared values, mutual respect, and the company culture. An excellent organizational environment is promoted with leadership, communication and shared goals associated with safety, profitability, and other key factors. The best companies guide and support their people and foster a culture of safety. We do not claim to offer the solutions to these organizational issues in this short article, but we acknowledge that environmental matters are every bit as critical as the other elements in PEAR.

Culture

An example program that has a notable, positive effect on corporate organizational culture is the FAA's Aviation Safety Action Program (ASAP) (www.faa.gov/safety/programs_initiatives/aircraft_aviation/asap/policy). ASAP is a cooperative arrangement where FAA joins with company management and its labor representation to report and correct errors as they occur. The result is a new level of teamwork that promotes non-punitive event reporting and clear communication to manage error and cost while ensuring continuing safety.

Successful HF programs carefully analyze



Physical Factors

- Physical size
- Gender
- Age
- Strength
- Sensory limitations

Physiological Factors

- Nutritional factors
- Health
- Lifestyle
- Fatigue
- Chemical dependency

Psychological Factors

- Workload
- Experience
- Knowledge
- Training
- Attitude
- Mental or emotional state

Psychosocial Factors

- Interpersonal conflicts
- Personal loss
- Financial hardships
- Recent divorce



Physical

- Weather
- Location inside/outside
- Workspace
- Shift
- Lighting
- Sound level
- Safety

Organizational

- Personnel
- Supervision
- Labor-management relations
- Pressures
- Crew structure
- Size of company
- Profitability
- Morale
- Corporate culture



- Steps to perform a task
- Sequence of activity
- Number of people involved
- Communication requirements
- Information control requirements

- Knowledge requirements
- Skill requirements
- Attitude requirements
- Certification requirements
- Inspection requirements



- Procedures/work cards
- Technical manuals
- Other people
- Test equipment
- Tools
- Computers/software
- Paperwork/signoffs

- Ground handling equipment
- Work stands and lifts
- Fixtures
- Materials
- Task lighting
- Training
- Quality systems

all the Actions people must perform to complete a job efficiently and safely. Job task analysis (JTA) is the standard HF approach to identify the knowledge, skills and attitudes needed to perform each task in a given job. JTA helps identify what instructions, tools, and other resources are necessary. Adherence to the JTA helps ensure that each worker is properly trained and that each workplace has the necessary equipment and other resources to perform the job. Many regulatory authorities require that the JTA serves as the basis for the company's general maintenance manual and training plan.

Many HF challenges associated with the use of job cards and technical documentation fall under Actions. A crystal clear understanding and

documentation of actions ensures that instructions and checklists are correct and useable.

Resources

The last PEAR letter stands for Resources. Again it is sometimes difficult to separate Resources from the other elements of PEAR. In general the characteristics of the People, Environment, and Actions dictate the Resources. Many resources are tangible, such as lifts, tools, test equipment, computers and technical manuals; others are less so. Examples are the number and qualifications of staff to complete a job, the length of time allocated, and the level of communication among crew, supervisors, vendors and others.

Resources should be viewed (and defined)

from a broad perspective. A resource is anything a mechanic (or anyone else) needs to get the job done. For example, protective clothing is a resource, a mobile phone can be a resource, rivets can be resources. What is important to the Resource element in PEAR is that one focuses on identifying the need for additional resources.

All regulatory authorities are beginning to require safety management systems (SMS). Regardless of the regulatory requirement, it makes good sense for an organization to have a formal process that identifies potential hazards and their associated level of risk.

As part of the company's SMS, policies must be established, hazards must be identified and mitigated, and the system monitored for acceptable safety. An SMS must be formalized, documented, and become the key element of a company's safety culture. The HF program, exemplified by PEAR, provides methods for identifying and controlling many of the potential hazards within an organization and should be an integral part of a company's SMS program. 

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* This article was prepared as a paper to guide HF training for the Aircraft Electronics Association.

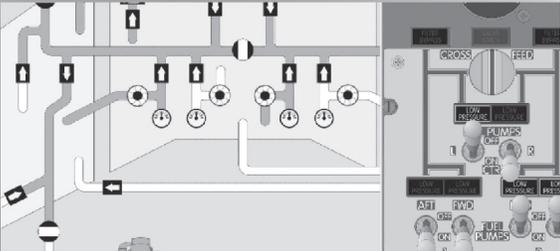
** Lufthansa has used the PEAR model in training since 1995, since then the company has delivered it to 10,000 employees and several thousand customers worldwide.

Further Reading

Return on Investment of Maintenance HF
<http://cat.texterity.com/cat/2006-4>

WATS 2006 Maintenance Proceedings
 - Taking HF to the Next Level of Maturity
 - Operator's Manual for HF in Maintenance
http://www.halldale.com/WRATS_Proceedings.aspx

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